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OBSERVATIONS ON THE ECOLOGICAL BEHAVIOUR OF SOME SPECIES OF THE *TULLBERGIA KRAUSBAUERI* GROUP

W. DUNGER

Staatliches Museum für Naturkunde - Forschungsstelle -
Görlitz, PSF 425, Görlitz 8900, German Democratic Republic

Before being splitted off by RUSEK the "species" *Tullbergia krausbaueri*, including forms highly adapted to euedaphic conditions, advanced to be most interesting for applied ecology. GISIN regarded it as an indicator of warm soils without excess of humidity and therefore of the best vineyard soils. GHILAROV discussed it as possible indicator of soil fertility at all. On the other side, PETERSEN found *Tullbergia krausbaueri* to be most abundant in young dunes and DUNGER as a pioneer in primary succession on recultivated soils. The new taxonomical statement was hoped to bring light into these ecological discrepancies. Up to date there are only few informations about the ecology of the new microspecies of the "*Tullbergia krausbaueri* complex" and new unsolved problems emerged. The following observations may be useful rather to see the problems better than to solve them.

At first, it might be asked if there is a succession of *Mesaphorura* and related species in primary colonization of recultivated soils. To find an answer, I revised the material of earlier studies (1960 - 1965; DUNGER 1968) on heaps of brown coal mining and reinvestigated the same plots 25 years later (fig.1). As a preliminary result, we find that nearly no species succession occurs. *Mesaphorura macrochaeta* is the first pioneer in tertiary-pleistocene mixed material and is still dominating after 35 years in the wood stage. *Mesaphorura hylophila* accompanies *M.macrochaeta* all the time. During the first 20 years it makes no difference whether the afforestation is made with decidous (N,A) or coniferous trees (Pinus). Later *Mesaphorura tenuisensillata* appears in a very small population in decidous stands exclusively. It is known as a spruce litter inhabiting species, but is still not found in the Pinus afforestation of Berzdorf heaps.

Exactly the same results from studies of primary colonization of acid tertiary material on heaps in the surroundings of Leipzig. There is only one addition: In agriculturally managed plots *Mesaphorura critica* and, very seldom, *M.italica* occur about 5 years after first recultivation. Quite the same experience is made in England by MOORE & LUXTON (1986), but there is one special shale heap firstly colonized by the new species *Mesaphorura atlantica*. HAGVAR (1982) supposed that the species composition of neighbouring sites is essentially for which species occurs as pioneer. At Berzdorf

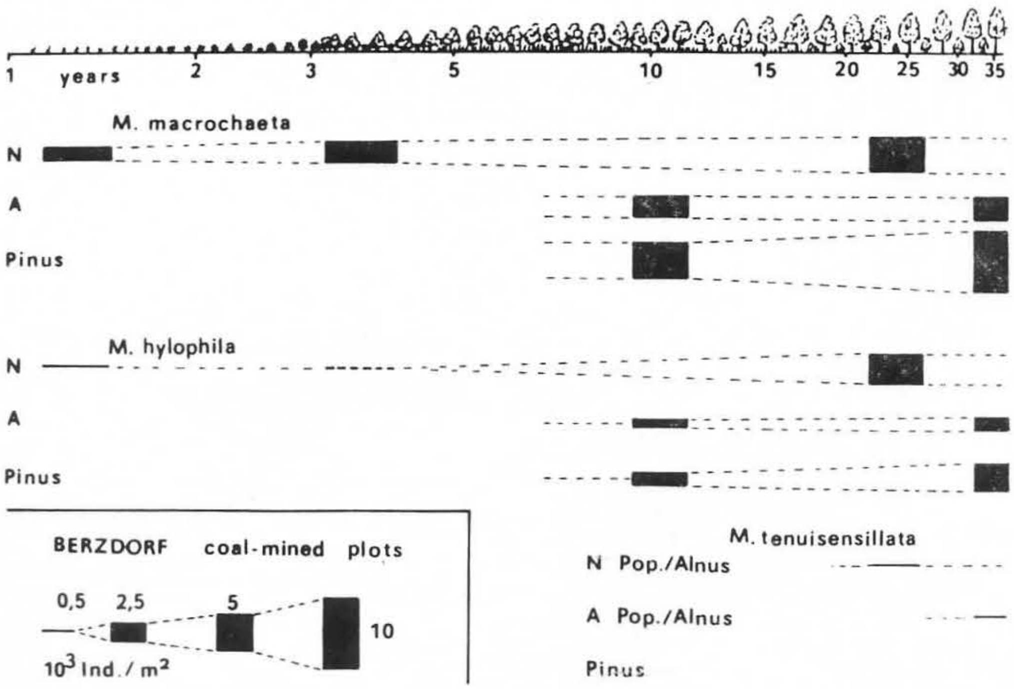
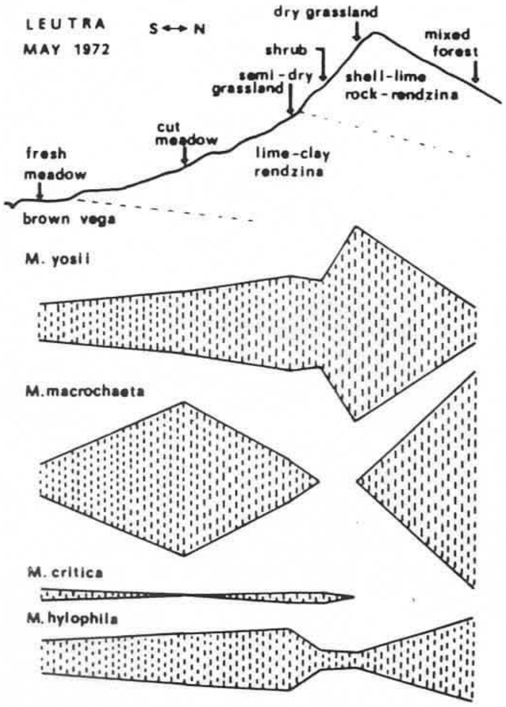


Fig. 1 Primary colonization of recultivated soils from brown coal mines (Berzdorf, Oberlausitz) by Mesaphorura species.

mine surroundings, there always may be present 2 to 5 species of Mesaphorura. Unfortunately, we know nothing about the mechanism of dispersion. Nevertheless it is obvious that M. macrochaeta is best adapted to a pioneer behaviour.

A second question: Is there a succession of Mesaphorura species along a catena of plots with characteristical factor gradients? Therefore I have revised some Mesaphorura material from a grassland-wood catena of the Leutratal in Thüringen (DUNGER 1978; fig.2). In the upper soil horizon the gradients of humidity and temperature exhibit a constant tendency along the slope, with highest temperature, lowest humidity and the most extreme variations in the dry grassland. Four species of Mesaphorura could be identified from Leutra. For Mesaphorura yosii the optimum lies in the most xerothermic parts of the catena. M.macrochaeta dominates in the more humid N-exposed wood as well as in the semi-dry grassland. This behaviour is astonishing if we bear in mind, that M. macrochaeta was found to colonize extreme plots as a pioneer. M.hylophila inhabits the slope nearly equally with exception of the most xerothermic plots. M.critica on the other hand is restricted to open, managed parts of the slope.
The third studied area (fig.3) is quite similar, but there is pollution from industry as a deciding factor (FRITZLAR,



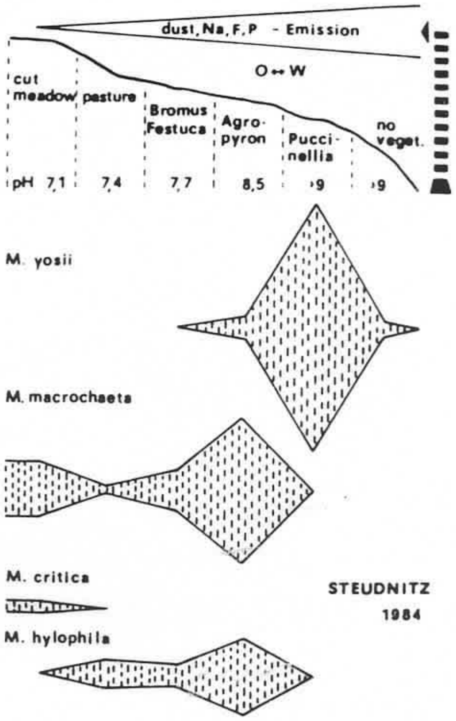


Fig.2 Relative abundance of Mesaphorura species in 6 plots of a xerothermic slope (Leutra, Thüringen).

Fig.3 Relative abundance of Mesaphorura species along a pollution gradient (Steudnitz, Thüringen).

DUNGER & SCHÄLLER 1986). Here, we see something like an inversion in the behaviour of some species. M.yosii is the only one to advance down to the most devastated zone without vegetation and dominates in the next affected Puccinellia stripe. With the decrease of the pollution effect, M.yosii is substituted or displaced by M.macrochaeta and M.hylophila. Again M.critica is restricted to the managed meadow. Considering the ecological amplitude of M.yosii, there are quite different findings in the literature. PONGE (1983) found this species to prefer acid and hydromorph soils. HAGVAR (1984) found laboratory populations of this species to increase with acidification but observed another field-response. He concludes that competition may be a major regulating factor. TAKEDA (1979) found M.yosii to be negatively correlated with soil moisture as it was in the Leutra population. Under the pollution stress M.yosii is the only species able to colonize the extreme basic site.

The results concerning vertical distribution are in a similar degree controversial. In Norwegian soils HAGVAR (1984)

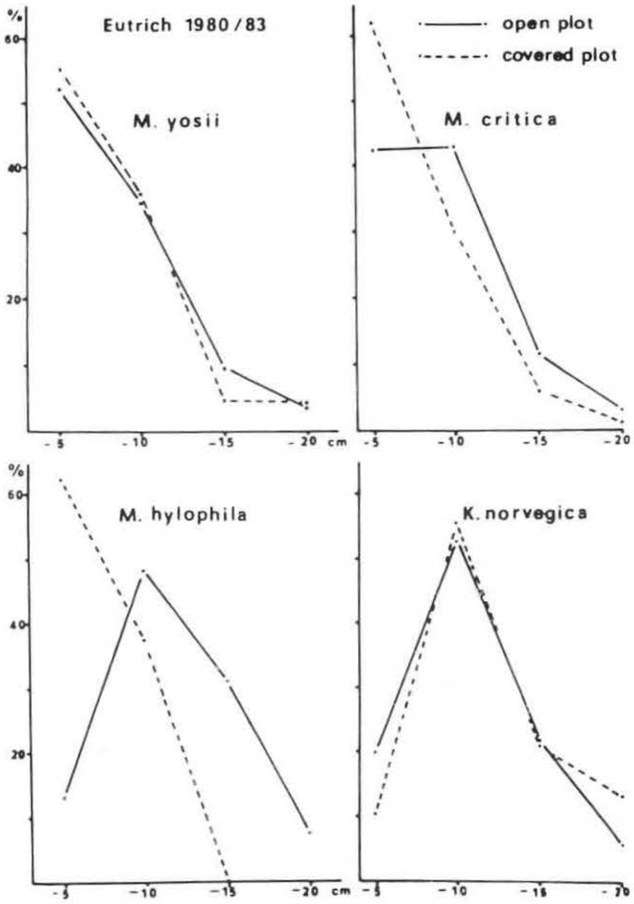


Fig. 4 Average percentage of Mesaphorura and Karlstejnia populations in 4 depth levels of dry sandy soil (Eutrich, Oberlausitz).

found M.macrochaeta in depths beneath 4 cm. In recultivated soils (Berzdorf-district) this species dominates as well in the upper soil layer as in 35 - 40 cm depth. In open dry sandy soils of a coniferous plantation near Eutrich (Oberlausitz; DUNGER 1984) M.macrochaeta did not appear. Here the dominating M.yosii was on average mostly concentrated in the upper 5 cm, as well in open plots as under low vegetation cover (fig. 4). These findings do not correspond with the results of HAGVAR who found M.yosii to prefer 3 - 7 cm depth. According to this author, Karlstejnia norvegica clearly prefers the deeper soil layer. In M.critica and even more in M.hylophila the vertical distribution seems to be determined by humidity. Under vegetation cover, they concentrate in the top soil, but migrate deeper in open sandy plots.

We have seen that in most of the studied areas 2 to 5 species of the "*Tullbergia krausbaueri* complex" live together. This leades to the question whether there is a strong niche segregation or not. Our present knowledge is to poor to decide it, but there seem to be more or less wide overlaps. In the studied species, we probable have the best segregation between *M.macrochaeta* and *M.yosii*. However, an important futural task will be to clear up, whether these species have such an extremely wide ecological amplitude indeed or belong to taxa which are to be separated further. The genetical status of all these mostly parthenogenetical species, their mechanisms of dispersion and their ecological behaviour continues to be an interesting field of study. There is quite a lot of work to do before this species complex possibly may be used as sensitive indicators.

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